

We Claim:

~~CLAIMS:~~

1. A data transaction device having contact and contactless modes of operation, comprising: .

a semiconductor device for operating in said contact and contactless modes in accordance with a respective contact or contactless data communications protocol,

a contact field including contacts fixedly connected to the semiconductor device for allowing data transmission between the contacts and the semiconductor device in accordance with said contact data communications protocol,

a coil antenna for allowing contactless data transmission between the coil antenna and the semiconductor device, in accordance with said contactless data communications protocol, and

an antenna interface coupled to the coil antenna, to the semiconductor device and to at least some of the contacts in the contact field and being responsive to an electromagnetic field across the coil antenna for effecting said contactless data transmission.

2. The data transaction device according to Claim 1, wherein the semiconductor device has separate contact and contactless i/o ports for effecting data transmission in accordance with said contact and contactless data communications protocol, respectively.

3. The data transaction device according to Claim 2, wherein the semiconductor device is responsive to a voltage level of the contactless i/o port on "power up" for selecting which of said communications protocols to enable.

4. The data transaction device according to Claim 1, wherein:

the semiconductor device is provided with clock, power and reset ports which are commonly connected to respective clock, power and reset connections in the contact field and antenna interface, respectively, and

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the clock, power and reset ports of the semiconductor device receive respective clock, power and reset signals via the contact field in said contact mode and via the antenna interface in said contactless mode.

5        5.        The data transaction device according to Claim 4, wherein in said contact mode the antenna interface is inactive and in said contactless mode the antenna interface is responsive to the electromagnetic field for supplying power to the semiconductor device.

10       6.        The data transaction device according to Claim 4, wherein in said contact mode the antenna interface is inactive and in said contactless mode the antenna interface is responsive to the electromagnetic field for supplying a clock signal to the semiconductor device.

15       7.        The data transaction device according to Claim 4, wherein in said contact mode the antenna interface is inactive and in said contactless mode the antenna interface is responsive to the electromagnetic field for supplying a reset signal to the semiconductor device.

8.        The data transaction device according to Claim 1, wherein the antenna interface is responsive to a voltage level across the coil antenna on "power up" for selecting in which of said modes to operate.

20       9.        The data transaction device according to Claim 3, wherein:  
the electromagnetic field is an amplitude modulated data carrier having superimposed thereon data to be read by the data transaction device,

the i/o port of the antenna interface is coupled to the contactless i/o port of the semiconductor device for allowing said contactless data transfer, and

25       the antenna interface includes a demodulator for amplitude demodulating data superimposed on the carrier, said demodulator having a demodulator input coupled to said coil antenna and a demodulator output coupled to said data i/o port for producing at said demodulator output a signal having a voltage level corresponding to said superimposed data.

10. The data transaction device according to Claim 3, wherein:

the electromagnetic field is an amplitude and/or phase modulated data carrier having superimposed thereon data to be written by the data transaction device to a remote device,

5 the contactless i/o port of the semiconductor device is coupled to a data i/o port of the antenna interface for effecting said contactless data transmission, and

the antenna interface comprises a modulator including a loading circuit having a loading circuit input coupled to the data i/o port and a loading circuit output coupled to the coil antenna for loading the coil antenna in response to said data fed to the loading circuit input by the semiconductor device.

11. The data transaction device according to Claim 3, wherein:

15 the electromagnetic field is an amplitude and/or phase modulated data carrier having superimposed thereon data to be written by the data transaction device to a remote device,

the contactless i/o port of the semiconductor device is coupled to a data i/o port of the antenna interface for effecting said contactless data transmission, and

20 the antenna interface comprises a modulator including a decoupling circuit controlled by the semiconductor device so as effectively to decouple the coil antenna from the antenna interface in response to data generated by the semiconductor device.

12. The data transaction device according to Claim 1, wherein the data transmission is bi-directional.

25 13. The data transaction device according to Claim 3, wherein:

the data transmission is bi-directional,

the contactless i/o port of the semiconductor device is coupled to a data i/o port of the antenna interface for effecting said contactless data transmission, and

the antenna interface includes:

a demodulator for amplitude demodulating data superimposed on the carrier, said demodulator having a demodulator input coupled to said coil antenna and a demodulator output coupled to said data i/o port for producing  
5 at said demodulator output a signal having a voltage level corresponding to said superimposed data, and

a modulator including a loading circuit having a loading circuit input coupled to the data i/o port and a loading circuit output coupled to the coil antenna for loading the coil antenna in response to data fed to the loading  
10 circuit input by the semiconductor device.

14. The data transaction device according to Claim 3, wherein:

the data transmission is bi-directional,

the contactless i/o port of the semiconductor device is coupled to a data i/o port of the antenna interface for effecting said contactless data  
15 transmission, and

the antenna interface includes:

a demodulator for amplitude demodulating a signal representative of data superimposed on the carrier, said demodulator having a demodulator input coupled to said coil antenna and a demodulator output coupled to said  
20 data i/o port for producing at said demodulator output a signal having a voltage level corresponding to said superimposed data, and

a modulator including a decoupling circuit controlled by the semiconductor device so as effectively to prevent the antenna interface from supplying energy to the remaining circuitry in the data transaction device, in  
25 response to data generated by the semiconductor device.

15. The data transaction device according to Claim 10, wherein the modulator is responsive to a signal representative of data bits fed thereto by the semiconductor device for producing at an output thereof an encoded signal corresponding to a selected encoding scheme.

16. The data transaction device according to Claim 9, wherein the demodulator further includes means for decoding a signal representative of individual bit bits of said data so as to produce at said demodulator output a signal representative of said data.

5 17. The data transaction device according to Claim 1, wherein the antenna interface further includes integral customizing means for customizing and/or optimizing the antenna interface for a specific application.

10 18. The data transaction device according to Claim 17, wherein the customizing means includes an encoding means in respect of different circuit components in the antenna interface for encoding whether said circuit components are to be enabled or disabled.

19. The data transaction device according to Claim 17, wherein the encoding means is adapted to connect together several circuit elements in the antenna interface in a predetermined configuration.

15 20. The data transaction device according to Claim 17, wherein the customizing means includes an encoding means operatively coupled to a tuning capacitor within the antenna interface comprising a plurality of component capacitors selectably connectable in parallel under control of the encoding means so as to modify a net capacitance of the tuning capacitor.

20 21. The data transaction device according to Claim 17, wherein the customizing means includes an encoding means for encoding selection parameters in respect of different circuit components in the antenna interface so as to allow values of said circuit components to be selected.

25 22. The data transaction device according to Claim 1, wherein the antenna interface includes:

a mode detector for sensing a presence or absence of an electromagnetic field across the coil antenna for producing respective contactless and contact mode signals,

a reset circuit responsively coupled to the mode detector and being responsive to the contactless mode signal for feeding a reset signal RST to a reset port of the semiconductor device, and

5 a clock circuit responsively coupled to the mode detector and being responsive to the contactless mode signal for feeding a clock signal CLK to a clock port of the semiconductor device.

23. The data transaction device according to Claim 22, wherein the antenna interface further includes customization means for producing said contactless mode signal even in the absence of an electromagnetic field across the coil antenna, whereby the clock and reset circuits are responsive to the  
10 contactless mode signal for feeding the clock and reset signals, respectively, to the semiconductor device even in the absence of an electromagnetic field across the coil antenna.

24. The data transaction device according to Claim 1, wherein the contact  
15 data communications protocol conforms to ISO 7816.

25. The data transaction device according to Claim 2, wherein data may be present on the contact and contactless i/o ports simultaneously, and the semiconductor device is programmed to relate to the data on only one of the data lines or on both data lines simultaneously according to a predetermined  
20 protocol.

26. The data transaction device according to Claim 1, wherein the semiconductor device and the antenna interface are integrated on a single chip.

27. The data transaction device according to Claim 11, wherein the  
25 modulator is responsive to a signal representative of data bits fed thereto by the semiconductor device for producing at an output thereof an encoded signal corresponding to a selected encoding scheme.